



1. The figure above shows the temperature  $T$  at a position  $x$  feet from the corner of the room,  $t$  hours after the heater is turned on.
  - (a) Estimate  $\frac{\partial T}{\partial x}$  and  $\frac{\partial T}{\partial t}$  20 hours after the heater is turned on, at a point 15 feet from the corner of the room.
  - (b) Estimate  $\frac{\partial T}{\partial x}$  and  $\frac{\partial T}{\partial t}$  15 hours after the heater is turned on, at a point 11 feet from the corner of the room.
2. A one-meter long metal bar is heated unevenly, with temperature in  $^{\circ}\text{C}$  at a distance  $x$  meters from one end at time  $t$  given by

$$H(x, t) = 100e^{-0.1t} \sin(\pi x)$$

- (a) Calculate  $\frac{\partial H}{\partial x} \Big|_{x=0.2}$  and  $\frac{\partial H}{\partial x} \Big|_{x=0.8}$ . What are these expressions a function of? What is the practical interpretation (in terms of temperature) of these two partial derivatives? Explain why each one has the sign it does.
- (b) Calculate  $\frac{\partial H}{\partial t}$ . What is its sign? What is its interpretation in terms of temperature?